page 10, 1.1 Check and Reflect

4. **(e)** 13.0 m [right]
5. 45.0 km [W]
6. Distance = 11.0 m;
Displacement = 5.0 m [right]
7. $\Delta\vec{d}_{\text{groom}}$ = 0.50 m [right]
$\Delta\vec{d}_{\text{best man}}$ = 0.75 m [left]
$\Delta\vec{d}_{\text{maid of honour}}$ = 1.25 m [right]
$\Delta\vec{d}_{\text{flower girl}}$ = 1.50 m [left]

page 20, 1.2 Check and Reflect

3. **(i)** D **(ii)** C **(iii)** A **(iv)** B
5. 7 km [W]
8. 2.5 m farther after 5.0 s
11. Time = 13 s; Distance = 26 m
12. Time = 20 s; Displacement = 45 m [N]
13. **(1)** 22 s **(2)** 40 s **(3)** 14 s

page 30, 1.3 Check and Reflect

1. **(a)** 5.6 m/s² [forward]
(b) 2.8 m/s² [forward]
(c) 0.30 m/s² [forward]
3. **(i)** A **(ii)** B **(iii)** C **(iv)** D
4.

Time (s)	Velocity (m/s [forward])
0.0	1
2.0	4
4.0	8
6.0	0
8.0	−9

page 44, 1.4 Check and Reflect

7. 75 m/s [E]
8. 36 m/s [up]
11. 15 m/s² [E]
16. Acceleration = 1.25 m/s² [W];
Time = 8.00 s
17. **(a)** 81 km/h [N]
18. 0.333 m/s² [right]

page 53, 1.5 Check and Reflect

1. −0.24 m/s² [forward]
2. 11 s
3. 20 cm
4. 0.064 m/s² [N]
5. 75.0 m/s² [W]
6. 19.6 m
7. 0.41 m/s²
8. 59.9 m
9. 3.52 m/s² [S]
10. 9.30 m/s²
11. 23.3 m/s²
12. 75 m [right]
13. 1.67×10^5 m/s² [forward]
14. 9.5 m

page 63, 1.6 Check and Reflect

3. 1.61 m/s² [down]
4. 2.8 m
5. **(1)** 33 m **(2)** 26 m/s [down]
6. 0.365 s
7. 1.5 m
8. 47.9 m
9. 72.3 m
10. 1.6 s
11. 6.22 s
12. 9.27 m
13. 1.4 s
14. 2.4 m
15. 159 m, 5.69 s
16. 5.4 m/s [68°]
17. **(a)** 4.0 m/s²
(b) 5.0×10^3 m
(d) 7.0×10^3 m
18. 9.68 m/s [down]

page 65, Chapter 1 Review

3. **(a)** 1.0 m/s
(b) 0.033 m/s
(c) 1.7 m/s
4. 27.0 km [W]
5. 42 min
6. **(1)** 3.75 m/s
(2) −25.0 m [right] or 25.0 m [left]
(3) 1.25 m/s [left]
8. 2.8 s
9. 7.0 s
10. 0 m/s
11. 1.5 m/s [W]
13. 60 m [N]
14. 7.2×10^7 m/s²
15. 18 km [forward]
16. 34.5 km
17. 72 times faster
18. 1.1×10^2 km/h or 31 m/s
19. **(1)** 22.5 m/s [downhill]
(2) 2.81 m/s² [downhill]
20. **(1)** 1.3 m/s² [N]
(2) 10 m/s [N]
21. 1.9×10^2 s
22. **(1)** 16.0 m/s [S]
(2) 22.0 m/s [S]
(3) 0.267 m/s² [S]
23. 35 m/s
24. **(1)** 12.1 s **(2)** 39 m/s
26. **(1)** −20 km [right] **(2)** 0 m/s²
27. 9.03 s
28. 0.467 s
29. 0.298 m/s²
30. 24 km/h [E]
32. 11.2 m/s² [W]
33. 6.8 s
34. 1.17 s
35. 12 m
36. 9.29 m
37. 1.32 s
38. **(1)** 15.2 m **(2)** 17.3 m/s
39. **(1)** 2.0 s **(2)** 20 m/s

page 75, 2.1 Check and Reflect

3. 24 cm
4. 20 km
5. 2100 km
6. **(b)** 100 yards **(c)** 1000 yards
7. 100 km [S], 150 km [S],
and 200 km [S]
9. **(1)** 36.0 m **(2)** 8.0 m [down]

page 90, 2.2 Check and Reflect

4. d_y = −47.6 cm; d_x = −27.5 cm
5. **(a)** Distance = 2.95 km;
Displacement = 1.45 m [270°]
(b) Distance = 12 km;
Displacement = 3.4 km
[27° N of W]
(c) Distance = 522 m;
Displacement = 522 m
[16.7° E of N]
6. 2.0 km [45° S of E]
7. 178 m/s
8. 2.65 km [48° S of E]
9. Total displacement = 2.8 km
[49° N of W];
Average velocity = 3.0 km/h
[49° N of W]
10. **(a)** 27 m in both the *x* and *y* directions
(b) 54 m
11. 10.6 m [293°]

page 101, 2.3 Check and Reflect

5. **(a)** 79.0 s **(b)** 47 m; 79.0 s
6. **(a)** 233 km/h [N]
(b) 297 km/h [N]
(c) 267 km/h [83.1° N of W]
7. 400 s
8. 8.4×10^2 km/h [3.0° N of E]
9. Ground velocity = 2.8 m/s
[35° S of E]; Time = 19 min
10. 674 km/h [6.0° S of W]
11. **(a)** 4.7 m/s [32° W of N] **(b)** 200 s

page 112, 2.4 Check and Reflect

5. 2.0 m
6. Initial horizontal velocity
component = 22 m/s;
Initial vertical velocity
component = 15 m/s;
Up 12 m; Out 70 m
7. 7.2 m/s
8. 11 m/s

9. (a) 10.0 s **(b)** 542 m
(c) 20.5 s **(d)** 1.41 km
(e) Horizontal component = 68.8 m/s;
Vertical component = 103 m/s

page 114, Chapter 2 Review

2. x component $= -41$ m;
y component $= -37$ m
3. 0
7. (a) $\Delta\vec{d}$ = 5.0 m [N]
(b) $\Delta\vec{d}$ = 140 cm [E]
(c) $\Delta\vec{d}$ = 2.5 km [backward]
(d) $\Delta\vec{d}$ = 80.0 km [right]
8. 0
9. 3.9×10^2 km
10. Range = 86 m;
Maximum height = 31 m
11. 2.2×10^2 m horizontally; 2.8 s
12. (a) 6.4 m/s [51° E of N]
(b) 30 s
13. (a) 29° m/s **(b)** 23 m
(c) 7.5 m/s
14. 7.4 m/s [58°]
15. (a) 30° W of N **(b)** 3.5 m/s
(c) 144 s
16. 1.82 m
17. 39 s
18. 2.2 s
19. (a) 17° S of W **(b)** 95 km/h
20. 42.2°
21. 5.0 m
22. 60.96 m
23. (a) 120 km/h **(b)** east
24. 2.92 s; Distance = 59.9 m;
Maximum height = 10.5 m
25. 39.8°
26. (a) 36 s **(b)** 1.5 km

page 118, Unit I Review

3. (a) 0 m; 5.0 m
(b) −15.0 m/s; −5.47 m/s
5. 7.7 km [30° S of E]
6. 2.70 m/s [W]
8. 3.0 s; Distance = 78 m horizontally;
Maximum height = 11 m
13. 30 m/s
14. 32 km/h
16. (a) 30 m/s [90°] **(b)** 40 m/s [90°]
17. 12.1 km
18. 1.53 h
19. 5.8 m/s
20. 9.56 m/s^2
21. 8.1×10^2 km/h [4° W of S]
22. 70.4 m/s^2
23. 2.2 s
24. 57 m
25. (a) 51 s **(b)** 0.032 m/s^2
26. 13.5 m [forward]
27. 63 m
28. 99 km/h [W]
29. 1.5×10^2 m
30. 1.2 m/s [210°]; 4.4 m/s [210°];
6.7 m/s [210°]
31. 1.1×10^2 km/h [6.5° N of E]
32. 13.2 m/s^2
33. 375 m [N]
35. 1.9 m
36. (a) 707 m [45°] **(b)** 1600 m
37. 1.56 m/s [N]
38. 320 m [51.3° S of E]
40. 5.98 m/s^2
41. (a) 14.4 m/s [down] **(b)** 10.6 m
42. (a) 347 m
(b) 376 m
(c) 82.5 m/s [down]
43. 13 m/s [30°]

page 136, 3.1 Check and Reflect

3. (b) 300 N [forward]
4. (a) 0° **(b)** 180°
5. 1.47×10^2 N [13.0°]
6. 42 N [153°]
7. $\vec{F}_{T_1} = 1.5 \times 10^2$ N [125°],
$\vec{F}_{T_2} = 1.5 \times 10^2$ N [55.0°]

page 139, 3.2 Concept Check

$\vec{v}$ = 17 km/s [toward interstellar space]

page 146, 3.3 Concept Check

$\vec{F}_{net} = \vec{F}_{app}$ if $\vec{F}_f = 0$

page 148, 3.3 Concept Check

(a) a **(b)** a **(c)** $\left(\frac{1}{16}\right)a$ **(d)** 0

page 158, 3.3 Check and Reflect

5. (a) 26 kg **(b)** 15 m/s^2 [up]
6. 0.11 m/s^2 [in direction of wind]
7. (a) 75 N [97°] **(b)** 37 m/s^2 [97°]
8. 0.75 m/s^2 [right]
9. (a) (4.0-kg block) 1.3 m/s^2
[toward pulley], (2.0-kg block)
1.3 m/s^2 [down]
(b) 17 N

page 168, 3.4 Check and Reflect

7. 10 N, 10 N [toward spring scale]
8. (a) $\vec{F}_{X\text{ on }Y}$ = 12 N [right],
$\vec{F}_{Y\text{ on }\times}$ = 12 N [left]
(b) $\vec{F}_{X\text{ on }Y}$ = 12 N [right],
$\vec{F}_{Y\text{ on }\times}$ = 12 N [left]

page 178, 3.5 Concept Check

90°

page 190, 3.5 Check and Reflect

4. 2 N [backward]
5. 0.40
6. 2×10^3 N [backward]
7. 24°
9. 1.2 m/s^2 [uphill]
10. 16 m
11. 1.9 s

page 192, Chapter 3 Review

1. 5.00×10^{-2} m/s^2 [E]
3. 1850 N [W]
5. (a) 42 N [along rope connecting
foot to pulley]
6. 1.2×10^3 N [forward]
7. $(\vec{L})$ 3.7×10^6 N, $(\vec{R})$ 3.3×10^6 N
8. 7.5 N [backward]
9. (a) 3.4×10^2 N
(b) 1.4×10^3 N [forward]
(c) 3.4×10^2 N [backward]
10. (a) $\vec{F}_{net_A}$ = 36 N [W], $\vec{F}_{net_B}$ = 21 N [E]
(b) (curler A) 0.71 m/s^2 [W],
(curler B) 0.26 m/s^2 [E]
11. 0.38
12. 0.423
13. (a) 9.8×10^2 N
(b) (i) (60 kg) 2.0 m/s^2 [down],
(40 kg) 2.0 m/s^2 [up]
(ii) 4.7×10^2 N
(c) 9.4×10^2 N
14. 7.3×10^2 kg
15. 2×10^3 kg
17. (a) dry asphalt **(b)** either surface
(c) dry concrete **(d)** dry concrete
18. (a) 6.9 m/s^2 [backward]
(b) 1.2 s

page 201, 4.1 Concept Check

(a) $16g$ **(b)** $\left(\frac{1}{4}\right)g$ **(c)** g **(d)** g

page 202, 4.1 Check and Reflect

9. (b) 9.80 N/kg **(c)** g_{Banff}

page 205, 4.2 Concept Check

(a) $4F_g$ **(b)** $4F_g$ **(c)** $\left(\frac{1}{16}\right)F_g$

page 215, 4.2 Check and Reflect

3. (a) $\left(\frac{1}{4}\right)F_g$ **(b)** $\left(\frac{1}{2}\right)F_g$
4. (a) (i) 162 N **(ii)** 978 N
5. (b) (Deimos) 1.5×10^{14} N,
(Phobos) 5.3×10^{15} N
6. (a) 132 N [toward Earth's centre]
(b) about 13.5 times greater in
magnitude

page 229, 4.3 Check and Reflect

5. 2.5 N/kg [toward Earth's centre]
6. (b) (i) 1.6 N/kg **(ii)** 0.72 N/kg
(iii) 0.40 N/kg
(c) $4r_{Moon}$
7. 9.8 N/kg
8. 540 N [down]
9. (b) $(\vec{F}_g)$ 4.9×10^2 N [down],
$(\vec{w})$ 2.9×10^3 N [down]

10. (Figure 4.38) 2.45 m/s^2 [up], (Figure 4.40) 1.23 m/s^2 [down]

page 231, Chapter 4 Review

2. (balance) 5.0 kg, (spring scale) 19 N/kg

3. $g \propto M_{source}$

4. 3.8 N/kg [toward Earth's centre]

5. 1.4 s

7. **(a)** 222 N [toward centre of Mars] **(b)** 625 N [toward centre of Saturn]

8. 2.0×10^{-7} N

9. **(a)** 2.4×10^2 N **(b)** 7.1×10^2 N **(c)** 6.8 N

10. **(a)** 7.3 m/s^2 [down] **(b)** 12 s **(c)** 4.9×10^2 N [down]

page 234, Unit II Review

2. 86 N [350°]

6. 0.50 kg

7. **(a)** $4a$ **(b)** $\left(\frac{1}{4}\right)a$ **(c)** 0

8. 40.0 N

10. 15 N [up]

21. (mass m) F_g, (mass $2m$) $2F_g$

24. 306 N [357°]

25. 2.097 m/s^2 [W]

27. 4.0 s

28. **(b)** 8.58 N [0°]

29. 0.56 m/s^2 [in same direction as train A]

30. 8.0×10^4 N [up]

31. 2.2 m/s^2 [forward]

32. 10 N [up]

33. **(a)** 5.3 m/s^2 [right] **(b)** 4.8×10^2 N

34. 0.46

35. **(a)** 8×10^1 N [forward] **(b)** 2×10^1 N [forward] **(c)** 6×10^1 N [backward]

36. 3.2 m/s^2 [downhill]

37. 1.5 m/s^2 [up]

38. **(a)** 1.3 m/s^2 [toward object A] **(b)** (string between A and B) 51 N, (string between B and C) 44 N

39. 8.00 N [toward Earth's centre]

41. 8.57 N/kg [toward Earth's centre]

42. 24.3 N less on Mars

43. **(a)** **(i)** and **(ii)** 5.9×10^2 N **(iii)** 8.8×10^2 N **(iv)** 3.9×10^2 N **(b)** **(i)** and **(ii)** ($\vec{F}_g$) 5.9 $\times 10^2$ N [down], ($\vec{w}$) 5.9 $\times 10^2$ N [down] **(iii)** ($\vec{F}_g$) 5.9 $\times 10^2$ N [down], ($\vec{w}$) 8.8 $\times 10^2$ N [down] **(iv)** ($\vec{F}_g$) 5.9 $\times 10^2$ N [down], ($\vec{w}$) 3.9 $\times 10^2$ N [down]

44. ($\vec{F}_g$) 5.9 $\times 10^2$ N [down], ($\vec{a}$) 6.5 m/s^2 [down]

45. **(a)** 9.4 m/s^2 [down] **(b)** 11 N [up] **(c)** 11 N [down]

46. (Earth) 1.2 s, (Moon) 3.0 s

47. **(a)** 0.12 N [away from net] **(b)** -0.78 m/s^2 [toward net] **(c)** 8.9 s **(d)** no

51. **(a)** 3.7×10^7 N [down] **(b)** 1.3×10^7 N [forward] **(c)** 3.3 m/s^2 [forward]

52. **(a)** F_g from person on you is 5.8 times greater

page 268, 5.2 Check and Reflect

6. 0.2 s

7. 1.88×10^2 m/s

8. 26 m/s

9. 8.57 m/s^2

10. 12

11. 1.21 m/s

12. 0.0337 m/s^2

13. 1.7 Hz

14. 1.3 Hz or 78 rpm

page 286, 5.3 Check and Reflect

9. 0.723 AU

10. 1.36×10^3 m/s

11. 3.547 d

12. 1.43×10^4 m/s

13. 1.98×10^{30} kg

page 288, Chapter 5 Review

14. 4×

17. 2.0×10^1 m/s

18. 7.8×10^2 N

19. 44.3 m/s

20. 68.0 N [down]

21. 50.0 km/h

22. 7.83×10^2 m/s^2

23. 3.0×10^3 rpm

24. 107 448 km/h

25. 13.1 m/s

26. **(a)** 6.00×10^7 m/s **(b)** 1.20×10^{16} m/s^2

27. 18.0 AU

28. 1.09×10^{30} kg

29. **(a)** 1.16×10^{18} s or 3.68×10^{10} y **(b)** 5.15×10^{36} kg **(c)** 6.71×10^{-15} m/s^2

30. **(a)** 7.91×10^3 m/s **(b)** 5.98×10^{24} kg **(c)** 5.06×10^3 s

31. 2.01×10^{20} N

32. 0.430 d or 3.72×10^4 s

33. 5.50×10^3 m/s

34. **(a)** 4.01×10^{33} kg **(b)** 6.38×10^{11} m

page 305, 6.1 Check and Reflect

5. **(a)** 3.60×10^4 J **(b)** 1.18×10^4 J

6. 2.76×10^4 J

7. **(a)** -6.18×10^4 J **(b)** 7.55×10^4 J **(c)** 1.37×10^5 J

8. **(a)** 3.25 J **(b)** 0.073 m

9. **(a)** A = 2.04×10^5 J; B = 3.48×10^5 J

10. **(a)** -110 J **(b)** -33.8 J

11. **(a)** 160 J **(b)** 12.6 m/s

page 310, 6.2 Check and Reflect

5. 1.79×10^6 J; k_e

6. 3.54×10^5 J

7. **(a)** 5.10×10^3 J **(b)** 1.25×10^3 J **(c)** 3.85×10^3 J **(d)** 31.0 m/s [up]

8. **(a)** 288 J **(b)** 288 J **(c)** 126 J **(d)** 126 J

page 323, 6.3 Check and Reflect

7. 12.4 J

10. **(a)** 0.482 m **(b)** 3.08 m/s **(c)** 2.13 m/s

page 330, 6.4 Check and Reflect

4. 164 W

5. 1.50×10^6 W

6. 4.05×10^6 J

7. 380 N

8. 1.04×10^7 W

page 332, Chapter 6 Review

5. 3.27×10^5 J

6. **(a)** increases to 4×

7. **(a)** 5.12 m/s **(b)** 5.59 m/s

8. 1.70×10^2 N/m

9. 12.7 m

10. 2.30×10^4 W

page 336, Unit III Review

16. 1 J = 1 kg·m^2/s^2

29. 0.017 s

30. 62.5 Hz

31. 0.200 s

32. 1.02×10^3 m/s

33. 1.6×10^1 s

34. 3.09 m/s^2

35. 1.40×10^2 m/s

36. 7.10×10^{-3} N

37. **(a)** 28.1 m **(b)** 4 ×; 113 m

38. **(a)** 2.40×10^3 J **(b)** 1.41×10^3 J

39. **(a)** 2.80×10^3 N [0°] **(b)** 1.54×10^5 J **(c)** 3.79×10^5 J **(d)** 19.5 m/s

40. 1.03 m

41. (a) 1.20×10^3 J **(b)** 15.5 m/s

42. (a) 35.9 J **(b)** 0.814 m

44. (a) 2.60 J **(b)** 0.065 m

45. 1.32 m/s

46. (a) 1.31×10^5 J
(b) 917 m
(c) 295 m/s

47. (a) −8.91 J **(b)** −1.78 N

48. 3.68×10^3 W

49. 1.62×10^4 W

50. 60.0 m/s (216 km/h)

51. 3.63 m/s

52. (a) 4.01×10^{30} kg
(b) 4.27×10^{25} kg
(c) 2.18×10^3 m/s

54. (a) 7.75 m/s **(b)** 4.38 m/s

page 347, 7.1 Check and Reflect

7. 20.0 Hz

9. 2.50×10^2 Hz

10. 0.026 s

11. 0.0125 s

12. (a) 0.400 s **(b)** 1.50×10^2 wags

page 365, 7.2 Check and Reflect

4. 6.0 N opposite to the displacement

5. 1.6 m [down]

6. 19 N

7. 1.5 N/m

8. 0.342 N [forward]

9. 0.028 N/m

page 380, 7.3 Check and Reflect

6. 19.4 m/s

7. 1.5 m

8. 1.08×10^3 m/s^2 [left]

9. 1.3×10^3 N/m

10. 11.0°

11. 3.47 s

12. (a) 1.88 s
(b) 0.900 kg
(c) 16.7 m/s^2

13. 3.14 m/s

14. 7.99 cm [east]

15. 0.898 s

page 390, Chapter 7 Review

11. (a) 2.5 N [forward]
(b) 0.9 N

12. 250 Hz

13. 1.5 s

14. 10 Hz

15. 5.1 N [forward]

16. 2.00×10^2 N/m

17. (a) 2.0 N/m
(b) −0.40 N
(c) 0.30 m

18. 0.750 m

20. 24.8 cm

21. 3.00 s

22. 1.2 m/s

23. 0.0200 m [up]

24. 1.02 s

25. 0.65 m/s^2

26. (a) l/g **(b)** 0.796 m

27. (a) 1.26 m/s **(b)** 0.993 s

28. (a) 0.566 Hz

page 410, 8.2 Check and Reflect

5. 1.20×10^3 Hz

6. 2.07 m

7. 0.135 m

9. (a) 0.911 m **(b)** 3.91 m

page 428, 8.3 Check and Reflect

7. 0.106 m

9. 0.60 cm

page 434, 8.4 Check and Reflect

4. 748 Hz

5. 15.7 m/s (56.5 km/h)

page 436, Chapter 8 Review

5. 0.133 s

7. 0.833 cm

8. 8.6 cm

9. 2.73×10^{-2} m

10. (b) 5.6 m/s

12. (a) 2.5 Hz **(b)** 0.50 Hz

13. (a) 435 m/s **(b)** 777 Hz

14. (a) 19.7 cm **(b)** 59.0 cm

16. 1.4 cm

17. 308 Hz

18. 86.9 km/h (24.1 m/s)

19. 1.26×10^3 km/h

20. 694 Hz

21. 175 m/s; $f = \frac{2}{3}$ original

page 440, Unit IV Review

11. 2.5, 3.5

28. 3.06 N

29. 7.9 g

32. +1.25 m/s^2

33. 4.0 mN/m

34. (a) 0.100 m
(b) 2.24 m/s

35. 15 m/s

36. 6.73 s

37. 0.75 m/s

38. 15.9 m

41. 4.00×10^{14} Hz to 6.98×10^{14} Hz

42. 240 m

43. 0.294 m

44. 7.76 s

45. 120 m/s

46. (a) 10 antinodes
(b) 2.22 Hz

47. (a) 193 m/s
(b) 440 Hz

48. (a) 0.552 m
(b) 1.66 m

49. 8.62 m/s

50. (a) 1.28×10^3 Hz
(b) 9.96×10^2 Hz

page 449, 9.1 Concept Check

(a) $2p$ **(b)** $\left(\frac{1}{3}\right)p$ **(c)** p [W]

page 453, 9.1 Check and Reflect

8. 13 kg•m/s [S]

9. 1.2×10^2 m/s [N]

10. (a) 39 kg•m/s [210°]
(b) (bicycle) 42 kg•m/s [40.0° N of E]; (rider) 2.3×10^2 kg•m/s [40.0° N of E]; (system) 2.7×10^2 kg•m/s [40.0° N of E]

11. 0.16 kg

12. 7.91 kg•m/s [214°]

13. 75 m/s [S]

14. (a) 4.28×10^5 kg•m/s [W]
(b) 3.85×10^5 kg•m/s [W]

15. 1.36×10^5 kg

16. 32.6 m/s [W]

page 456, 9.2 Concept Check

$p_i \neq 0$

page 467, 9.2 Check and Reflect

4. (a) 2 × (impulse)
(b) $\frac{1}{3}$ × (impulse)

7. (a) 2.3 N•s
(b) 47 m/s [S]

8. 6.2 N•s [forward]

9. (a) 7.0×10^3 N•s [forward]
(b) 11 m/s [forward]

10. 12 s

11. 560 N [W]

12. 545 N•s [W]

page 486, 9.3 Check and Reflect

6. 0.018 m/s [away from bag]

7. 3.1×10^3 m/s [down]

8. 1.2 m/s [S]

9. 0.47 m/s [E]

10. (a) 1.11 m/s [right] **(b)** inelastic

11. (a) 274 kg **(b)** inelastic

page 499, 9.4 Check and Reflect

5. 0.505 m/s [320°]

6. 0.625 m/s [48.1° N of W]

7. inelastic, 0.098 J

9. 0.603 m/s [49.6° S of W]

10. 27.4 m/s [37°]

11. 27.0 m/s [349°]

page 503, Unit V Review

11. $\vec{P}_{sys_i} = \vec{P}_{sys_f}$ where $(\vec{F}_{net})_{sys} = 0$, (elastic collisions) $E_{k_i} = E_{k_f}$

15. $\Delta\vec{v}$

16. (a) $\vec{F}_{net}$ decreases **(b)** Δt increases

37. 1.4×10^4 kg•m/s [N]

38. 7.13 kg•m/s [26.0° S of E]

39. 1.85×10^4 kg•m/s [S]

40. 6.2 kg

41. 37 kg•m/s [W]

42. 2.4 kg•m/s [W]

43. (a) 7.5 N•s [S]
(b) 0.26 kg

44. (a) 3.02 N•s [210°]
(b) 6.9 m/s [210°]

45. 2.7×10^3 N [toward drop-off]

46. (a) 5.50×10^3 N•s [W]
(b) 7.75 s

47. 11.3 m/s [6.4° S of W]

48. (a) 7.6×10^3 N•s [forward]
(b) 22 m/s [forward]

49. (a) 3.00 N•s
(b) 10.9 m/s

50. 6.5×10^7 N [toward rocket]

51. 8.7×10^2 N [up]

52. (a) 12 N•s [toward pitcher]
(b) 1.6 N [away from bat]

53. 2.1 m/s [225°]

54. (a) 1.29 m/s [S]
(b) 1.29 m/s [S]

55. 0.750 m/s [backward]

56. 1.27×10^3 m/s [3.5°]

57. 3.5 m/s [65.3°]

58. 1.26 m/s [8.3° E of N]

59. (a) 1.8 m/s [1.8° E of N]
(b) elastic

60. 1.3 m/s [downhill]

61. 15.6 m/s [34.1° S of W]

62. (a) 17 m/s

63. 4.90 m/s [358°]

64. (a) 13.4 m/s [0°]
(b) inelastic

65. 4.21×10^{-25} kg•m/s [W]

66. (a) 3.46 m/s [4.7° W of N]
(b) elastic

67. (a) 40.0 kg

68. 33 m/s [72.5° N of W]

69. (a) 12 m/s
(b) 61.9° E of N

70. (a) 5.95 m/s [E]
(b) 2.76 s

71. 10 m/s [73.8° N of E]

72. 0.580 kg

73. 1.18 m/s [307.9°]

74. 0.641 m/s [S]

75. (a) S **(b)** NW **(c)** 248°

77. 10.5 m/s [46.4° W of S and 52.5° up]

80. (initial velocity of car) 90 km/h [W]; (initial velocity of truck) 88 km/h [N]

82. 6.1×10^2 m/s

page 538, 10.2 Check and Reflect

5. (a) 20 N **(b)** 40 N

6. (b) 3.1×10^{10} electrons

7. (a) 6.74 N—repulsive
(b) 6.80 N—repulsive

8. (a) 1.21×10^{10} N toward charge B
(b) 7.50×10^9 N toward charge A

page 540, Chapter 10 Review

11. 1.69 N—repulsive

12. 6.70×10^3 m

13. (a) 1.60×10^{10} N [left]
(b) 1.24×10^{10} N [left]

22. (a) 160 N (b) 6.7 N

24. X—2.43×10^{12} N [upward];
Y—2.43×10^{10} N [210°];
Z—2.43×10^{10} N [330°]

25. (b) F_e varies as $1/r$ or $1/r^2$
(e) 0.0360 N•m^2
(f) kq_1q_2
(g) 2.00×10^{-6} C

page 553, 11.1 Check and Reflect

7. (a) 4.50×10^5 N/C [right]
(b) 9.00×10^{-3} N [right]

8. (a) 2.04×10^4 N/C [toward the larger sphere]
(b) $+3.63 \times 10^{-9}$ C

9. (a) 2.50×10^{10} N/C [toward the 3.00 C charge]
(b) 0.661 m left of the −3.00 C charge

page 569, 11.2 Check and Reflect

4. (a) 2.40×10^{-17} N [downward]
(b) 1.64×10^{-26} N [downward]

6. 1.60×10^3 N/C

7. 7.21×10^5 N/C [toward the -6.4 μC charge]

8. 2.00×10^3 J

9. 1.78×10^6 N/C [left]

10. (a) 2.00×10^4 V/m
(b) 3.86×10^{-5} J

page 575, 11.3 Check and Reflect

4. Speed of electron is 8.79×10^6 m/s; speed of proton is 2.05×10^5 m/s

5. 9.4×10^7 m/s

6. 6.00×10^{-19} C

7. 2.40×10^{-4} J

8. (a) 1.38×10^6 m/s
(b) 9.79×10^5 m/s

9. (a) 1.8×10^{-5} J
(b) 1.8×10^{-5} J
(c) 1.1 m/s

10. (b) 2.00×10^{-17} N
(c) 2.20×10^{13} m/s^2
(d) 0.129 m

page 578, Chapter 11 Review

12. $E_p = W$

17. (a) 5.17×10^3 N/C
(b) 1.03×10^{-2} N

18. (a) 7.50×10^{10} N/C [toward the −5.00 C charge]
(b) 0.735 m from the −5.00 C charge

19. 1.2×10^7 N/C [90.0°]

20. (a) 3.0 J **(b)** 3.0 J

21. 5.62×10^4 J

22. (a) 160 V/m
(b) 6.00 V

24. 7.0×10^5 V/m

25. 2.88×10^{-13} J or 1.80×10^6 eV

26. 6.40×10^{-15} J or 4.00×10^4 eV

page 601, 12.2 Check and Reflect

6. (a) 6.40×10^{-15} N
(b) 3.67×10^{-15} N

7. 1.3×10^6 m/s

8. 6.53×10^{-26} N

9. 1.06×10^{-4} m

10. 8.31×10^{-9} T

page 613, 12.3 Check and Reflect

9. 1.04×10^{-2} C

11. 8.4×10^{-2} N

page 622, Chapter 12 Review

20. 9.86×10^{-14} N

21. (a) 2.3×10^4 m/s
(b) 4.42×10^{-19} J or 2.76 eV

22. 4.08×10^{-3} m/s

23. (a) 4.13×10^{-16} N
(b) 2.06×10^{-16} N
(c) no force

24. 2.7×10^{-5} T

26. (b) B varies as $1/r$ or $1/r^2$

28. 25.0 N

page 626, Unit VI Review

40. (a) 1.4×10^8 V/m
(b) 1.1×10^{-19} J

42. 2.56×10^{-9} m

43. 5.06×10^7 N—repulsive

46. 15 N/C

47. 3.2×10^{-15} J; maximum speed is 1.96×10^6 m/s

48. 0.268 m to the right of the first charge

49. 5.0×10^{-5} C

50. 0.73 A

51. (a) 2.6×10^6 N/C [left]
(b) 1.62 N—attractive

53. 1.96×10^{-3} N

54. 1.67×10^{-4} m

55. (a) 3.63×10^{-47} N
(b) 8.22×10^{-8} N
(c) 2.27×10^{39} times greater

58. 1.53×10^{-3} m/s

59. **(a)** 3.17×10^{-12} N
(b) 1.89×10^{-2} m

60. **(a)** 113 N [right]
(b) 28.4 N [left]
(c) 30.8 N [69.4°]

61. 6.6×10^{3} V

62. **(a)** 2.50×10^{4} V
(b) 9.37×10^{7} m/s
(c) 2.25×10^{-11} N

82. **(b)** B varies as 1/r
(c) Plot B vs 1/r
(f) 0.791
(g) 0.789

page 647, 13.1 Check and Reflect

8. 2.5×10^{3} Hz

page 652, 13.2 Check and Reflect

4. 2.1×10^{8} m/s

5. 6.67×10^{-2} s

6. 293 Hz

7. 2.7×10^{3} Hz

8. 3.44×10^{4} m

9. 1.86×10^{3} Hz

10. 2.80×10^{8} m/s

11. 2.85×10^{8} m/s

page 665, 13.3 Check and Reflect

8. 50 cm

page 683, 13.4 Check and Reflect

9. 2.26×10^{8} m/s

10. 23.0°

11. 32.4°

12. 41.1°

14. angle of refraction = 15.9°;
wavelength = 351 nm

16. -2.25×10^{-2} m; inverted

18. **(a)** 648 cm
(b) 140 cm
(c) 8.19 cm

page 697, 13.5 Check and Reflect

6. 5.7×10^{-6} m

7. 6.10°

8. 0.350 m

9. 3.76×10^{-3} m

10. wavelength = 6.11×10^{-7} m;
frequency = 4.91×10^{14} Hz

11. wavelength = 4.13×10^{-7} m;
frequency = 7.26×10^{14} Hz

page 699, Chapter 13 Review

24. **(a)** 2.26×10^{8} m/s
(b) 2.19×10^{8} m/s
(c) 1.97×10^{8} m/s
(d) 2.04×10^{8} m/s
(e) 1.24×10^{8} m/s

25. 3.41×10^{4} m

26. 2.88×10^{8} m/s

28. 12.5 cm

32. 5.00 cm high, 6.67 cm from the mirror

33. 1.82 cm

34. angle of refraction = 23°;
wavelength = 415 nm

35. **(a)** no **(b)** yes **(c)** yes **(d)** no

36. 1.12, which is less than that of water

37. **(a)** 48.8° **(b)** 24.4°
(c) 33.3° **(d)** 41.1°

39. 2.67 cm high, 3.33 cm from the lens.
It is virtual, erect, and diminished.

40. 0.68°, 1.4°, 2.0°

41. 4.4×10^{-7} m; violet

42. 4.9×10^{-7} m; blue

43. 6.0×10^{-5} m

page 710, 14.1 Check and Reflect

1. 4.42×10^{-19} J

2. 8.29×10^{-8} m

4. **(a)** 2.4×10^{19} Hz

5. 2.8×10^{21} photons

6. 4.9×10^{21} photons

7. 100 photons/s

page 715, 14.2 Concept Check

$E_{\text{photon}} = hf > W$

page 720, 14.2 Check and Reflect

1. 3.11 eV

3. 9.82×10^{14} Hz

4. yes, $hf > W$

5. 1.25 V

9. 6.56×10^{-34} J•s; this is close to
Planck's constant

Page 725, 14.3 Check and Reflect

1. 1.33×10^{-27} N•s

3. wavelength = 1.11×10^{-13} m;
energy = 1.80×10^{-12} J

6. 0.0124 nm

7. 2.0×10^{4} m/s

page 736, 14.4 Check and Reflect

1. 36.4 nm

2. 1.33×10^{-27} kg•m/s

3. 5.3×10^{-26} kg•m/s

4. 2.1×10^{-23} kg•m/s

5. **(a)** 3.36×10^{-15} J
(b) 8.47×10^{-12} m

page 742, Chapter 14 Review

3. 4.42×10^{-19} J or 2.76 eV

7. 4.0×10^{-19} J or 2.5 eV

9. It increases by 0.0024 nm.

10. 73 nm

11. 6.63×10^{-27} N•s

13. 3.0×10^{18} photons

14. 3.62×10^{-19} J or 2.26 eV

15. 0.00388 nm

16. **(a)** 1.1×10^{-34} m

17. 6.28×10^{9} photons/s

18. 3.32×10^{30} photons/s

19. 0.52 eV, 2.1 eV, 4.7 eV

20. 5.33×10^{-23} kg·m/s

22. **(a)** 3.87×10^{21} photons/s/m^2
(b) 2.41×10^{-27} kg·m/s
(c) 9.3 N

23. 1.5×10^{17}

page 746, Unit VII Review

26. 3.62×10^{-19} J

29. 6.00×10^{14} Hz

33. 3.88×10^{-7} m (388 nm)

36. 2.21×10^{-27} N·s

37. 0.243 nm

41. 8.3×10^{29} photons/s

43. 3.84×10^{5} km

45. 4.84×10^{4} m

46. 3.75×10^{3} Hz

47. 1.39×10^{-4} s

49. refractive index = 2.42, therefore
the material is diamond

51. 2.91×10^{8} m/s; error = 3%

53. 7.5 cm from mirror. It is erect and
2.5 cm high.

55. 8.6°

57. 10 cm from the lens

58.(b) 0.105 m/s

60. 0.0045 nm

62. 0.38 eV

63. for violet light 24.8°;
for red light 40.5°

64. 2.62×10^{-2} m

67. Energy = 0.24 eV;
momentum = 2.6×10^{-25} N•s

68. 6.67×10^{-2} s

71. 41 light years

76. momentum = 1.2×10^{-22} kg•m/s;
wavelength = 5.5×10^{-12} m

78. 6.63×10^{-26} N•s

page 760, 15.1 Check and Reflect

1. **(a)** 8.0×10^{-15} N
(b) 0 N

4. **(b)** 400 m/s

5. 1.8×10^{9} m/s

6. 1.57×10^{-3} T

8. 3.0×10^{3} m/s

9. **(a)** 8.0×10^{-15} N [downward]

10. **(b)** 3.0×10^{9} m/s

page 765, 15.2 Check and Reflect

3. -6.40×10^{-19} C

4. 8.00×10^{-17} N [up]

5. **(a)** 0 N

6. **(a)** -1.6×10^{-18} C, or $-10e$
(b) 10
(c) It will accelerate downward at $2g$.

page 770, 15.3 Check and Reflect

3. (a) 3.6×10^{-16} J
(b) 3.6×10^{-12} J

6. (a) 1.6×10^{-10} m
(b) The gold atom is approximately 7000 times larger than the gold nucleus.

7. (b) 5.0×10^{-15} m

page 780, 15.4 Concept Check

634 nm, 654 nm

page 780, 15.4 Check and Reflect

5. (b) 486 nm
(c) 4.09×10^{-19} J

6. 1.96 eV

7. (b) 1 = 1.9 eV; 2 = 2.1 eV; 3 = 1.5 eV; 4 = 3.9 eV
(c) λ_1 = 654 nm, visible, red; λ_2 = 592 nm; visible, yellow-orange; λ_3 = 829 nm; λ_4 = 319 nm

9. (a) 3.03×10^{-19} J
(b) 2.66×10^{-20} J

11. (a) 140 nm **(b)** 3271 nm **(c)** 15

page 784, 15.5 Check and Reflect

4. (a) 3.32×10^{-10} m
(b) 2.00×10^{-24} kg·m/s
(c) kinetic energy = 2.18×10^{-18} J; velocity = 2.19×10^{6} m/s

5. (a) $\lambda_2 = 2\lambda_1$; $\lambda_3 = 3\lambda_1$

page 786, Chapter 15 Review

6. 3.68×10^{-18} C

7. -1.76×10^{11} C

16. 4.76×10^{-10} m

19. 2.4×10^{-16} N

20. (a) 1.09×10^{6} m/s

21. 4.1×10^{4} N/C directed upward

22. (a) 1.06×10^{-19} J; 1.55×10^{-19} J; 1.82×10^{-19} J
(b) wavelengths: 1880 nm, 1280 nm, 1100 nm. Frequencies: 1.60×10^{14} Hz, 2.34×10^{14} Hz, 2.74×10^{14} Hz.
(c) 1.55×10^{-19} J

23. (b) 634 nm

24. 2.5×10^{3} N/C

25. (a) 2.17×10^{-18} J
(b) 9.0×10^{22} m/s^2
(d) 4.7×10^{-11} s

page 796, 16.1 Check and Reflect

1. (a) 38 protons, 52 neutrons
(b) 6 protons, 7 neutrons
(c) 26 protons, 30 neutrons
(d) 1 proton, 0 neutrons

2. 1.0×10^{9} eV = 1.0 GeV

3. 230 MeV

4. 5.56×10^{-8} kg

7. 177.772 MeV

8. (a) 0.366642 u
(b) 8.53818 MeV/nucleon

9. (a) 91 MeV
(b) 476 MeV
(c) 1700 MeV

12. Nuclear radius ≈ 5.4 fm. Approximate distance between nucleons = 1.9 fm

page 810, 16.2 Check and Reflect

8. 2.84 MeV

page 817, 16.3 Check and Reflect

1. $\frac{1}{16}$

2. 3.7×10^{12} atoms/s

4. 1.2 million years

5. 1.7×10^{-3} of the original quantity

6. 11500 years

7. 153 Bq

8. (a) 5 h
(b) 3477 decays/min

Page 824, 16.4 Check and Reflect

6. (b) 4.73 MeV

7. (b) 17.6 MeV

8. (a) 8.10×10^{19}
(b) 998 kg

Page 826, Chapter 16 Review

5. 60 neutrons, 55 protons

6. 8.0×10^{-12} J

7. 9×10^{13} J

8. 3.44×10^{-10} J

9. 0.32 u

10. 20.5 MeV

18. 180 MBq

19. 1.6×10^{19} nuclei

24. (a) 7.074 MeV
(b) 8.448 MeV
(c) 8.792 MeV
(d) 7.591 MeV

26. (b) 8.95 MeV

27. (b) 2.33 MeV

28. 11500 years

29. (a) 5.05×10^{15} atoms
(b) 1.90×10^{-9} kg
(c) 1.15×10^{4} Bq

30. (a) 400 Bq **(b)** 3 h

31. 7.27 MeV

32. (b) 233 g

page 844, 17.3 Check and Reflect

7. (a) momentum = 4×10^{-21} kg•m/s; kinetic energy = 8×10^{-15} J
(b) momentum = 8.4×10^{-22} kg•m/s; kinetic energy = 2.1×10^{-16} J

8. (a) 0.51100 MeV
(b) 5.521×10^{-27} kg

9. 931.5

page 851, Chapter 17 Review

19. 3.14×10^{-25} kg

20. (a) +e
(b) 83−138 MeV/c^2

21. (b) 135 MeV/c^2

22. (b) 10 cm
(c) p = (1.2 T)q(0.10 m)

page 855, Unit VIII Review

2. 9.6×10^{7} C

3. -1.60×10^{-18} C

4. 1.60×10^{-16} N [N]

8. (a) $n_i = 4 \rightarrow n_f = 1$ and $n_i = 6 \rightarrow n_f = 2$
(b) $n_i = 1 \rightarrow n_f = 5$
(c) $n_i = 6 \rightarrow n_f = 2$

10. 33 neutrons, 31 protons

12. 1.96×10^{7} eV

13. 1.0×10^{-9} J

14. 6.7 MeV

15. 2.3×10^{9} decays/s

17. 1.4 g

22. (c) 2.4×10^{-12} m

25. (a) proton
(b) kaon
(c) pion
(d) Σ^-

27. (b) 730 m/s

28. 0.48 T

29. (a) magnetic force = 2.0×10^{-13} N [up]; electric force = 1.60×10^{-17} N [up]
(b) 2.0×10^{-13} N [up]

30. (a) -1.6×10^{-18} C
(b) It has gained 10 electrons.

31. (a) 1005 nm, 1094 nm, 1282 nm, 1875 nm
(b) infrared

32. (a) 2.12×10^{-10}
(b) 6.64×10^{-10} m
(c) 9.98×10^{-25} kg·m/s
(d) speed = 1.10×10^{6} m/s; kinetic energy = 5.46×10^{-19} J

33. 342.06 MeV

36. 10.42 MeV

37. 7.5%

38. 1.91 MeV; cesium−140

39. 122 Bq

40. 1.72×10^{4} years old

41. 7.161 MeV

42. 4.033 MeV

44. (a) 2×10^{2} N
(b) 2×10^{-13} J

45. 51 km/s

46. (b) 135 MeV

48. 2.7×10^{-18} N•s

49. 2.33×10^{-50} m

50. (a) 13 Bq

51. (a) the level of 21.9 Sv is much higher than the background level of 400 μSv
(b) 468 m

52. (b) The matter — anti-matter reaction is more than 150 times more powerful than nuclear fusion.

53. 0.22 g deuterium, 0.33 g tritium

54. 0.5 years

56. 777 nm photon emitted

57. 3.73×10^{-11} J

58. 2.12×10^{-10} m

59. (a) The $n = 3$ state
(b) 1.89 eV

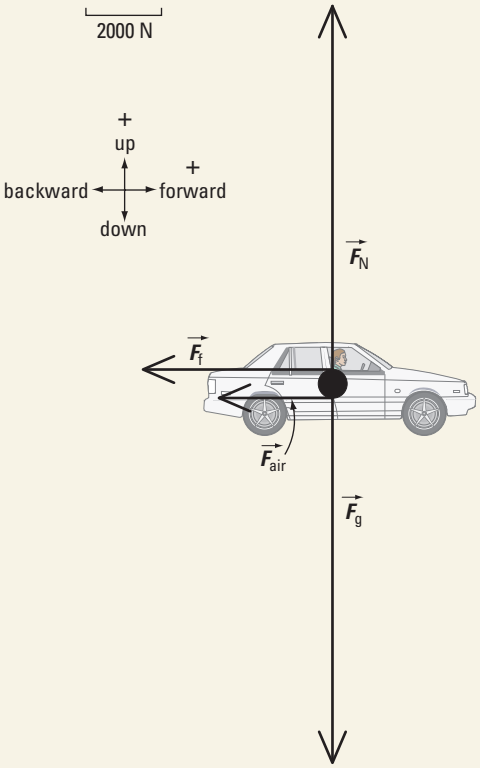
60. 198.3 MeV

62. +1

63. 5.25×10^{5} Bq

page 131, Example 3.1 Practice Problems

1.



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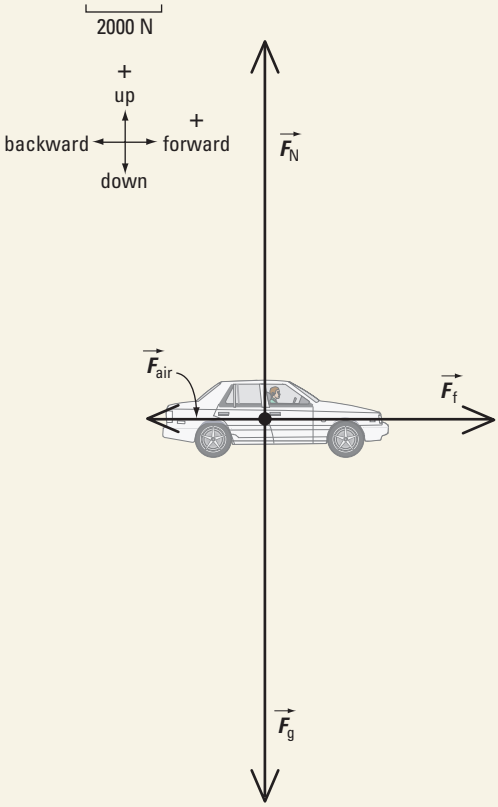

page 225, Example 4.7 Practice Problem

1.